

## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

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## (PCT Article 36 and Rule 70)

Applicant's or agent's file reference P3173 WO ORD	<b>FOR FURTHER ACTION</b>		See Form PCT/PEA/416
International application No. PCT/GB2004/004181	International filing date (day/month/year) 01.10.2004	Priority date (day/month/year) 01.10.2003	
International Patent Classification (IPC) or national classification and IPC C02F11/12			
Applicant ELECTROKINETIC LIMITED et al.			
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 6 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> <i>(sent to the applicant and to the International Bureau)</i> a total of 5 sheets, as follows:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</li> <li><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</li> </ul> <p>b. <input type="checkbox"/> <i>(sent to the International Bureau only)</i> a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p> <p>4. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Box No. I Basis of the opinion</li> <li><input type="checkbox"/> Box No. II Priority</li> <li><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li> <li><input type="checkbox"/> Box No. IV Lack of unity of invention</li> <li><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li> <li><input type="checkbox"/> Box No. VI Certain documents cited</li> <li><input checked="" type="checkbox"/> Box No. VII Certain defects in the international application</li> <li><input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application</li> </ul>			
Date of submission of the demand 11.06.2005	Date of completion of this report 19.01.2006		
Name and mailing address of the International preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Glod, G Telephone No. +49 89 2399-7373		



**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/GB2004/004181

**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
  - This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
    - international search (under Rules 12.3 and 23.1(b))
    - publication of the international application (under Rule 12.4)
    - international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

**Description, Pages**

1-29 as originally filed

**Claims, Numbers**

1-20 received on 11.06.2005 with letter of 09.06.2005

**Drawings, Sheets**

1-4 as originally filed

- a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3.  The amendments have resulted in the cancellation of:
  - the description, pages
  - the claims, Nos.
  - the drawings, sheets/figs
  - the sequence listing (*specify*):
  - any table(s) related to sequence listing (*specify*):
4.  This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
  - the description, pages
  - the claims, Nos.
  - the drawings, sheets/figs
  - the sequence listing (*specify*):
  - any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-20
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-20
Industrial applicability (IA)	Yes:	Claims	1-20
	No:	Claims	

**2. Citations and explanations (Rule 70.7):**

**see separate sheet**

**Box No. VII Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**Box No. VIII Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

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**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

1. Reference is made to the following documents:

D1: US-A-4802964

D2: US-A-5891342

2. The subject-matter of claims 1-20 does not fulfill the requirements of Article 33(3) PCT (Inventive step).
- 2a. D1, which is considered to represent the most relevant state of the art, discloses (see fig. 2) an apparatus comprising containment means 101, 102, to apply pressure to the contained material, the containment means being partly defined by one first sheet member 102 comprising a first filtration membrane permeable to the liquid but impermeable to some of the solids contained within the material, wherein the filtration membrane comprises one conductive element in integral association with at least a part thereof so as to constitute where so associated a composite first electrode and being further partly defined by at least one second sheet 101 member comprising one conductive element in integral association with at least a part thereof so as to constitute where so associated a composite second electrode, the first and second electrodes being remotely spaced from each other in contact with the material to allow application of a potential difference across the material.

The subject-matter of claim 1 of the present application differs from D1 in that the two filtration membranes are made of textile or other synthetic material and are permeable to the liquid.

The problem to be solved by the present invention may therefore be regarded as providing a material for a pressing belt that works as an electrode for reducing the liquid content of a material comprising a particulate/liquid mixture and as increasing hydraulic functionality.

D2 discloses a sludge dewatering process wherein, the sludge is transported

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between two belts 13,15, at least one of which being porous, and an increasing excessive force is applied to the sludge bed. The press belt comprises a polyester spiral fabric having all the synthetic polymer stuffer yarns located in the coils replaced with one or more metal strips or yarns. The metal strips or yarns, which are charged by way of a wiper 16, serve to act as a cathode, while the carbon steel press rollers act as alternate anodes and cathodes.

The skilled person would seriously contemplate the use of the polyester spiral fabric of D2 in an apparatus of D1; in addition the possibility of both belts being porous is also given in D2, since **at least one** is porous. The skilled person would thus apply the teaching of D2 to D1 and arrive at an apparatus, wherein the anode would be formed by rollers.

There is no indication in the application that the incorporation of the anode in the membrane has any technical advantage as compared to using a porous membrane with anodes formed by rollers. Therefore making the second filtration membrane also of a textile or other synthetic material having at least one conductive element in integral association with at least part thereof has to be considered as obvious alternative that the skilled person would arrive at without the exercise of inventive skill.

The subject-matter of claim 1 cannot be considered as inventive.

- 2b. The same argumentation applies to independent claim 16.
- 2c. As mentioned above D2 discloses a method for hydraulic pressure dewatering of sludge by incorporating a conductive filter membrane, instead of a conventional one, thus improving conventional hydraulic filtration. The man skilled in the art would, whenever necessary, and without the use of inventive activity, use such an apparatus instead of a conventional one, thus incorporating a conductive filter membrane. Therefore, the subject-matter of independent claim 20 lacks an inventive step.
- 2d. Dependent claims 2-15 and 17-19 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT with respect to inventive step, said features being either known from the prior art documents D1 and/or D2 or conventional in the field of dewatering systems.

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**Re Item VII**

**Certain defects in the international application**

3. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in D1 and D2 is not mentioned in the description, nor are these documents identified therein.

**Re Item VIII**

**Certain observations on the international application**

4. In claims 1 and 16 the expression "when the filtration" after "within the material" is not clear (Article 6 PCT); it was interpreted as meaning "wherein the second filtration".  
In claim 8 (line 1) "the belt" was interpreted as "the belts" since said claim is otherwise unclear.

CLAIMS

1. An apparatus for reducing the liquid content of a material comprising a particulate/liquid mixture, the apparatus comprising containment means to contain the material, and means to apply pressure to the contained material therein; the containment means being partly defined by at least one first sheet member comprising a first filtration membrane permeable to the liquid but impermeable to at least some and more preferably substantially all of the solids contained within the material, wherein the filtration membrane comprises a textile or other synthetic material having at least one conductive element in integral association with at least a part thereof so as to constitute where so associated a composite first electrode; and being further partly defined by at least one second sheet member comprising a second filtration membrane permeable to the liquid but impermeable to at least some and more preferably substantially all of the solids contained within the material when the filtration membrane comprises a textile or other synthetic material having at least one conductive element in integral association with at least a part thereof so as to constitute where so associated a composite second electrode; the first and second electrodes being remotely spaced from each other in contact with the material to allow application of a potential difference across the material.
2. An apparatus according to claim 1 wherein the means to apply pressure acts to urge the first and second sheet members into closer association with each other, reducing the distance between them so as to apply hydraulic pressure to the material to be dewatered.

3. An apparatus according to any preceding claim configured as a belt filter press wherein at least one of the belts is a first filtration membrane and at least one of the belts is a second filtration membrane in accordance with any preceding claim integrally associated with a conductor so as to function respectively as a first/second electrode for at least a part of the length thereof.
- 5
4. An apparatus according to claim 3 configured such that the containment means defines a conduit with an input for material to be dewatered, an output for dewatered material, a means to apply pressure therealong, a 10 first belt member comprising a filtration membrane substantially along the length thereof, the filtration membrane being associated with a conductor for at least a part of the length thereof to form a first electrode, and a second belt member spaced apart from the first belt member to retain material to be dewatered therebetween, the belt member being associated with a conductor for at least a part of the length thereof to form a second electrode such as to allow an application of potential difference across a material to be dewatered 15 within the conduit.
- 15
- 20
5. An apparatus according to one of claims 3 or 4 wherein the means to apply pressure along the conduit acts to urge the belts towards each other to induce a hydraulic pressure in the material to be dewatered therebetween, and is so arranged that this pressure is increased as the material passes along the conduit.
- 25
6. An apparatus according to one of claims 3 to 5 wherein each belt is disposed as a continuous belt around a plurality of pressure rollers and/or guide rollers, each roller being an insulator at least on a contact surface thereof.
- 30

7. An apparatus according to one of claims 3 to 6 wherein the edges of each belt are provided with an insulating surface coating to permit the edges of opposing belts to touch without creating a short circuit.
- 5
8. An apparatus according to one of claims 3 to 7 wherein the belt is a woven belt, the conducting elements comprise an array of weft elements disposed generally transversely to the belt, and additional transfer elements are located generally toward one of both edges of the belt and extending longitudinally therealong, incorporated into the warp so as to be in electrical contact with the weft elements, but woven in such manner as to be partly exposed on the surface of the belt.
- 10
9. An apparatus according to any preceding claim wherein the filtration membrane is a sheet material having a primarily non-conductive polymeric base structure, being woven, knitted, needle-punched, non-woven or otherwise fabricated, and including conducting elements within or on the sheet structure in intimate association.
- 15
- 20 10. An apparatus according to claim 9 wherein the conducting elements are elongate conducting elements comprising thread, tape, wire or the like
- 25
11. An apparatus according to claim 10 wherein the sheet structure is woven or knitted and the elongate conducting elements are woven or knitted into the sheet.
12. An apparatus according to one of claims 9 to 11 wherein the conducting elements constituting at least one of the electrode sheets disposed as an anode in use comprise metallic elements coated in mixed metal oxide.

13. An apparatus according to any one of claims 1 to 8 wherein the filter membrane comprises an inherently conducting material.
14. An apparatus according to claim 13 wherein the filter membrane comprises polymeric material loaded with carbon.  
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15. An apparatus according to any preceding claim wherein the filtration membrane comprises a plurality of discrete conductive regions.
- 10 16. A method of removal of liquid from a material comprising a mixture of solid particles and liquid the method comprising the steps of:  
containing the material within a containment means, which containment means is at least partially defined by at least one first sheet member comprising a first filtration membrane permeable to the liquid in the material but impermeable to at least some, and preferably substantially all, of the solid components of the sludge slurry or tailings, the filtration membrane comprising a filtration material having at least one conductive element in integral association with at least a part thereof to serve as a first electrode; and is further partly defined by at least one second sheet member comprising a second filtration membrane permeable to the liquid but impermeable to at least some and more preferably substantially all of the solids contained within the material when the filtration membrane comprises a textile or other synthetic material having at least one conductive element in integral association with at least a part thereof so as to constitute where so associated a second electrode;  
15 applying pressure to the material to induce hydraulic drainage through the filtration membrane;  
applying a potential difference between the first and second electrodes  
20 to induce electro-osmotic drainage through the filtration membrane.  
25
- 20 30

17. A method according to claim 16 wherein the potential difference is applied across a controlled area of the material only, by applying a power source to only a part of the conductive area or to one or a few of a plurality of discrete conductive zones on the filtration membranes.
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18. A method according to claim 16 or 17 comprising a continuous belt process, wherein the containment means is provided as a conduit with an input for material to be dewatered having full liquid content and an output for material to be dewatered where the liquid content has been reduced and a means to apply pressure there along;
- 10
- The method comprising feeding material to be dewatered into the input, causing the material to travel therealong, applying pressure and potential difference thereacross to reduce the liquid content by simultaneous application of hydraulic and electro-osmotic drainage effects, and removing the sludge slurry or tailings at the output.
- 15
19. A method according to one of claims 16 to 18 applied to the treatment of sludge, slurries, mineral wastes, slimes, muds, dredgings or tailings by dewatering.
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20. A method of modifying a conventional hydraulic pressure dewatering apparatus comprises incorporating a conductive filter membrane as an in situ, retrofitted modification.

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